0714 40491896 3.0

Superfund

OU-01

Gravatt, Dan

From: Terrie Boguski <tboguski@skeo.com>
Sent: Sunday, April 06, 2014 4:58 PM
To: Gravatt, Dan; Field, Jeff
Cc: Kirby Webster
Subject: FYI - WLL lab uncertainty answer

Hi Dan,

In case it is helpful to you, the message that I shared with the CAG Board after talking with Mike McDougall is pasted below. I got a response back from the person who asked the question. He said it was helpful.

Terrie

Today, I talked with Mike McDougall, the laboratory manager for Eberline Anayltical. Eberline conducted the analysis of radionuclides in the ground water for the August 2012, April, July and October 2013 ground water sampling events. Paul Rosasco was also on the call. I asked Mike why many of the Thorium results in the October ground water monitoring report for the filtered sample (dissolved) were higher than the results for the unfiltered sample from the same well.

Mike explained that most people read laboratory results as absolute numbers, but in reality each result has an uncertainty associated with it. The uncertainty is sample specific, so it isn't possible to simply say the results are uncertain within a range of ± some percent. Radiochemistry results can have a very high uncertainty because the laboratory is counting radioactive emissions. If you look at the units of measure fact sheet, you will see that 1 picocurie = 2.2 disintegrations per minute (dpm). If the count is high, there is less uncertainty in the laboratory result than if the count is low. Since the activity of the radionuclides in the ground water samples is close to background, the uncertainty can be fairly high. Mike also said that if the sediment in the unfiltered sample is low in activity, it can cause a dilution effect when compared to the filtered sample results because the same total mass is used for each sample. In addition to these specific causes, there is the propagation of error through the whole sampling and analysis process that adds up and contributes to the uncertainty, which is what I was talking about in my previous email, i.e. "things happen".

As an example, if we compare two results of 2 and 3. It looks like 3 is greater than 2. But, if we know that the results are really 2 ± 1 and 3 ± 1.5, we would understand that the comparison is actually between two ranges of results that overlap. In comparing the ranges of (1 to 3) and (1.5 to 4.5). We would see that we really can't say that the results are actually different because the numbers are too uncertain to make that determination. Even though each reported laboratory value isn't listed with its uncertainty, EPA staff who use the data to make decisions will be aware of the issue of uncertainty.

In my previous email, I mentioned the October ground water monitoring report results for thorium for monitoring well 1204. The dissolved sample for Well 1204 is 19.46 pCi/L and the unfiltered or total sample for Well 1204 is 0.35 pCi/L. The difference in these results can't really be explained by overlap in uncertainty. The values are "orders of magnitude" different. Paul pointed out during the conversation with Mike that the Th-228 Th-230 and Th-232 results for MW-1204 in Table 4 (page 35 of the Oct 2013 report) are marked with an R, which means that the results were rejected by the independent reviewer. When laboratory data are rejected it means that the reviewer thinks something went wrong in the analysis and the results cannot be trusted. Summing these rejected results was an oversight in the report.

In the above paragraph, I mention "orders of magnitude" difference between numbers. This is a helpful concept when reviewing environmental data. An order of magnitude is 10x or another decimal place. So, 19.46 is 2 orders of magnitude different than 0.35. An order of magnitude difference in results makes the difference quite important. If I see results for a monitoring well over time that look like this: 1.2, 6.0, 3.3, 2.0, my reaction is that not much is happening in that well. But, if I see results that show an order of magnitude difference over time, such as 2.0, 12.1, 200, then I think something dramatic is happening in that well.

I hope this additional information about the laboratory results uncertainty is helpful. If you have other questions, please let me know and I will try to get answers.